Testing Models of Human Facial Biomechanics with In Vivo Strain Data on Retracted Versus Protracted Faces

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Abstract:
The human face differs from most other primates in that it lacks a rostrum and is oriented primarily in the coronal plane. These differences may influence biomechanical resistance to torsional, shearing, and bending forces generated during mastication that are known to affect the growth of the maxillary and mandibular arches. We tested the effects of facial retraction on facial strain patterns using in vivo strain data collected from rock hyraxes (Procavia capensis) and pigs (Sus scrofa). The postcanine tooth row in hyraxes is retracted beneath the orbits, as in humans, but lies anterior to the orbit under a rostrum in pigs. Average shear strains recorded for hard foods on the anterior dorsal rostrum (lateral to the midline) were 65 μ€ in the pigs, and 25 μ€ in the hyraxes. Average shear strains on the dorsal interorbital surface (lateral to the midline) were 125 μ€ in the pigs, and 320 μ€ in the hydraxes. Although some bending occurred, torsion about an A-P axis was the major mode of deformation during mastication in both species. The lower rostral strains and higher caudal strains in the hyrax relative to the pig support the notion that facial retraction decreases resistance to masticatory forces in the superior portion of the face, but this effect is only moderate in the experiment. In both species, applied stresses are effectively generated in the rostrum and/or lower face, suggesting that a similar pattern may be inferred for the human face.